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Improved heat conductor support disc

Technical Field of the Invention

The present invention relates to the field of heating elements for industrial furnace applications, in particular to an improved heat conductor support disc for use in a heating element.

Background of the Invention

In industrial furnaces employed in the processing of materials and products at high temperatures, electrical heating elements are positioned and supported by ceramic discs. Typically, the heating resistor elements or heat conductors are inserted through apertures in the discs. In such discs, a centre aperture for a supporting element is located on a symmetrical axis in the centre of the disc. Apertures for heat conductors are provided uniformly distributed on at least one circle coaxial with a respective disc centre. During service such discs tend to break due to thermal stresses induced in the disc.

The prior art can be exemplified by US-B1 5,543,603, which hereby is incorporated by reference. This US patent shows discs as described above.

Summary of the Invention

The object of the present invention is to provide a ceramic heat conductor support disc for supporting electrical heating elements for heating furnaces, which discs have a much lower tendency to break due to thermal stresses.

Thus, the present invention refers to a ceramic heat conductor support disc for supporting an electrical heating element for electrically heated furnace installations, said support disc having a centre aperture lying parallel to the longitudinal axis of the heating element and one or more apertures located between said centre aperture and the periphery of the disc, and is characterized in, that the disc is provided with one or more elongated openings running from

said periphery to one of said apertures, where each elongated opening penetrates the whole thickness of said disc.

It is another object of the present invention to provide a heat conductor support disc which allows higher energy rates to the elements.

It is still another object of the present invention to provide an improved heat conductor support disc for use at higher temperatures.

It is yet another object of the present invention to provide a heat conductor support disc with improved properties at higher thermal cycling rates.

Short Description of the Drawings

- Figures 1A and 1B shows a view of a first embodiment of a ceramic disc according to the present invention
- Figure 2A and 2B shows a view of a second embodiment of a ceramic disc according to the present invention
- Figure 3A and 3B shows a view of a third embodiment of a ceramic disc according to the present invention
- Figure 4A and 4B shows a view of a fourth embodiment of a ceramic disc according to the present invention
- Figure 5A and 5B shows a view of a fourth embodiment of a ceramic disc according to the present invention.

In the respective figures A is a planar view and B is a cross section of the respective discs.

Detailed Description of the Invention

In figure 1A a ceramic heat conductor support disc 1 for supporting an electrical heating element for electrically heated furnace installations is shown in a planar view. Said support disc 1 has a centre aperture 2 lying parallel to the longitudinal axis of the disc. Further, the disc is provided with one or more

apertures 3 and 6 located between said centre aperture 2 and the periphery 4 of the disc. The apertures can be circular or can be of another shape such as an elliptical aperture/ 15, see Figure 5A.

The periphery can have a wave shape or another shape such as circular.

According to the invention the disc is further provided with one or more elongated openings 5 running from said periphery 4 through one of said apertures 6. The elongated opening penetrates the whole thickness of said disc 1.

The electrical heating element is supported by two or more discs 1 located in row after each other, where the element runs through the said apertures.

The disc 1 is typically made of pure oxides or a mixture of oxides of the elements Al, Si, Mg, Zr and/or Y, nitrides respectively borides of the elements Si and/or Ti or other suitable heat resistant ceramic materials.

A preferred embodiment can comprise 40 – 100 weigth-% Al_2O_3 and 60 – 0 % SiO_2 plus some additives, such as for promoting the process when the disc is sintered.

The elongated opening and/or openings can be produced by pressing, sawing or extruding processes before or after firing.

Typically the heating element has a temperature that is higher than the temperature of the furnace when operated. When the furnace is turned off, the temperature of the heating element will decrease to about the furnace temperature. There are such applications where the furnace is cyclically turned on and off, i.e. exposed to extremely high cyclic thermal stress. There are also applications where the elements are operating continuously, where extremely high cyclic thermal stress occurs during e.g. changing elements.

By the invention it is obtained, that mechanical stresses that are induced thermally, when the disc is heated to its operating temperature and that are induced when the temperature of the disc varies, will not reach the critical value for initiating a crack starting from the periphery of the disc and running inwardly.

The maximum value of such stresses is limited by means of the presence of the elongated opening, which gives that the thermally induced tensile stresses at the periphery will be limited.

According to a preferred embodiment of the invention the length of said elongated opening 5 is limited to the maximum radius of the disc 1.

According to one embodiment said elongated opening runs along a radius of said disc 1, as illustrated in figures 1A and 3A by the openings 5 and 7.

According to an alternative embodiment said elongated opening runs in another direction than along a radius of said disc 1, as illustrated in figures 2A and 4A by the openings 8, 9.

According to another preferred embodiment the width of the elongated opening 5, 7, 8, 9 is limited to the diameter of the aperture 6, 2, 10 and 11 in which it ends.

As is shown in figures 2A and 4A the elongated opening 8, 9 may well run through apertures 12, 13, 14

According to still another preferred embodiment the elongated opening has the same width, or a width that varies, over the length of the elongated opening.

According to yet another preferred embodiment said elongated opening ends in the center aperture 2, as illustrated in 1A and 2A.

According to yet another embodiment of the invention there are two or more of said elongated openings 16, 17 in the disc 1 as illustrated in figure 5A.

In figure 5A it is illustrated that the holes 3 can be asymmetrically located as well as the two elongated openings can be directed in different directions. The holes 3 can be concentrated to one side of the disc, thereby concentrating the radiation in that direction.

Since there is one or more elongated openings in said disc, values relating to the maximum mechanical stress for a disc 1 of the present invention are in a range of more than 50 - 70% of the disc of the state of the art.

In addition the mechanical strength has different values in different directions, which is of importance for the positioning of the disk in the heating application. It is therefore advantageous to place the different discs, located one after the other along the length of the heating element, such the discs are rotated so that the elongated opening of the respective disc points in different radial directions.

Claims

1. A ceramic heat conductor support disc for supporting an electrical heating element for electrically heated furnace installations, said support disc having a centre aperture (2) lying parallel to the longitudinal axis of the heating element and one or more apertures (3, 6, 10–15) located between said centre aperture (2) and the periphery (4) of the disc (1), c h a r a c t e r i z e d in, that the disc (1) is provided with one or more elongated openings (5,7,8,9,16,17) running from said periphery (4) to one or through one or more of said apertures (3, 6, 10–15) and/or the centre aperture (2), where each elongated opening penetrates the whole thickness of said disc (1).

2. Disc according to claim 1, c h a r a c t e r i z e d in, that the length of said elongated opening (5,7,8,9,16,17) is limited to the maximum radius of the disc (1).

3. Disc according to claim 1or 2, c h a r a c t e r i z e d in, that said elongated opening (5,7) runs along the radius of said disc (1).

4. Disc according to claim 1 or 2, c h a r a c t e r i z e d in, that said elongated opening (8,9,16,17) runs in another direction than along the radius of said disc (1).

5. Disc according to claim 1, 2, 3 or 4, c h a r a c t e r i z e d in, that the width of the elongated opening (5,7,8,9,16,17) is upwards limited to the maximum diameter of the aperture (3,6,10-15) and/or the centre aperture(2), in which it ends.

6. Disc according to claim 1, 2, 3, 4 or 5, c h a r a c t e r i z e d in, that the elongated opening (5,7,8,9,16,17) has the same width, or a width that varies, over the length of said elongated opening.

7. Disc according to claim 1, 2, 3, 4, 5 or 6, c h a r a c t e r i z e d in, that said elongated opening (5,7,8,9) ends in the centre aperture (2).

8. Disc according to claim 1, 2, 3, 4, 5, 6 or 7, c h a r a c t e r i s e d I n, that there are two or more of said elongated openings (16, 17) in the disc (1).

9. Disc according to claim 8, c h a r a c t e r i z e d in, that the apertures (3,6, 10-15) are located asymmetrical over the disc surface.

10. Disc according to any of claims 1-9, c h a r a c t e r i z e d in, that said centre aperture (2) and said apertures (3,6,10-15) have an elliptical shape.

11. Disc according to any of claims 1-9, c h a r a c t e r i z e d in, that said centre aperture (2) and said apertures (3,6,10-15) have a circular shape.

Abstract

A ceramic heat conductor support disc for supporting an electrical heating element for electrically heated furnace installations, said support disc having a centre aperture (2) lying parallel to the longitudinal axis of the heating element and one or more apertures (3,6,10–15) located between said centre aperture (2) and the periphery (4) of the disc (1).

The invention is characterized in, that the disc (1) is provided with one or more elongated openings (5,7,8,9,16,17) running from said periphery (4) to one of said apertures (3,6,10–15) and/or the centre aperture (2), where each elongated opening penetrates the whole thickness of said disc (1).

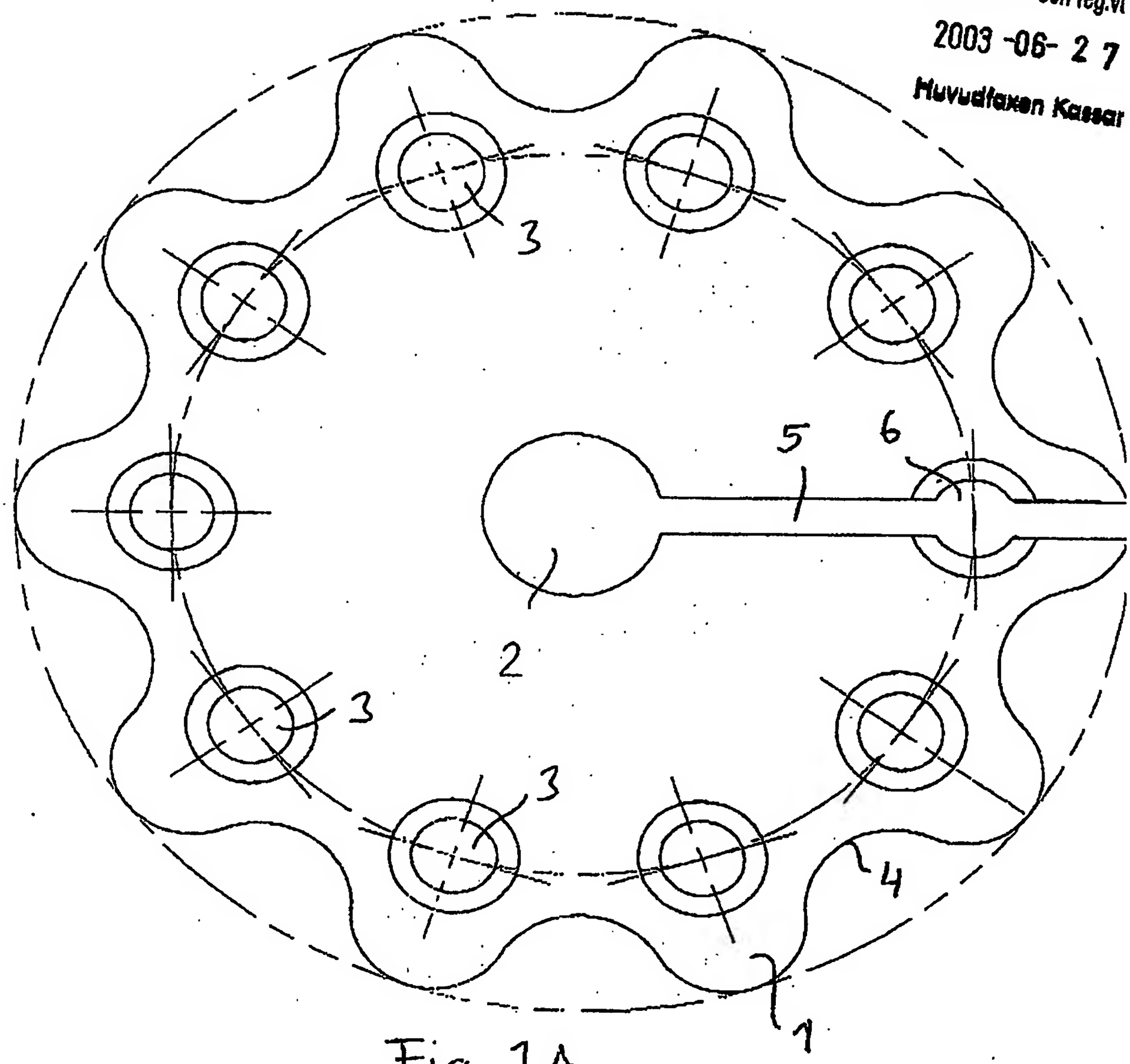


Fig 1A

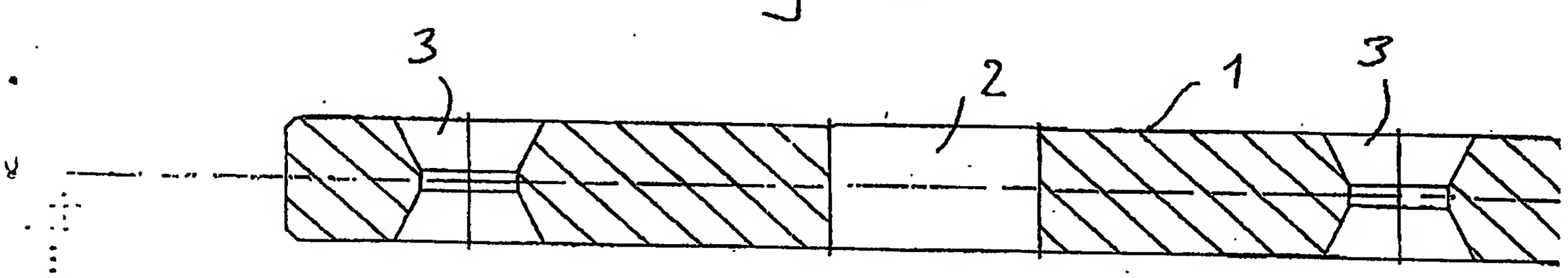


Fig 1B

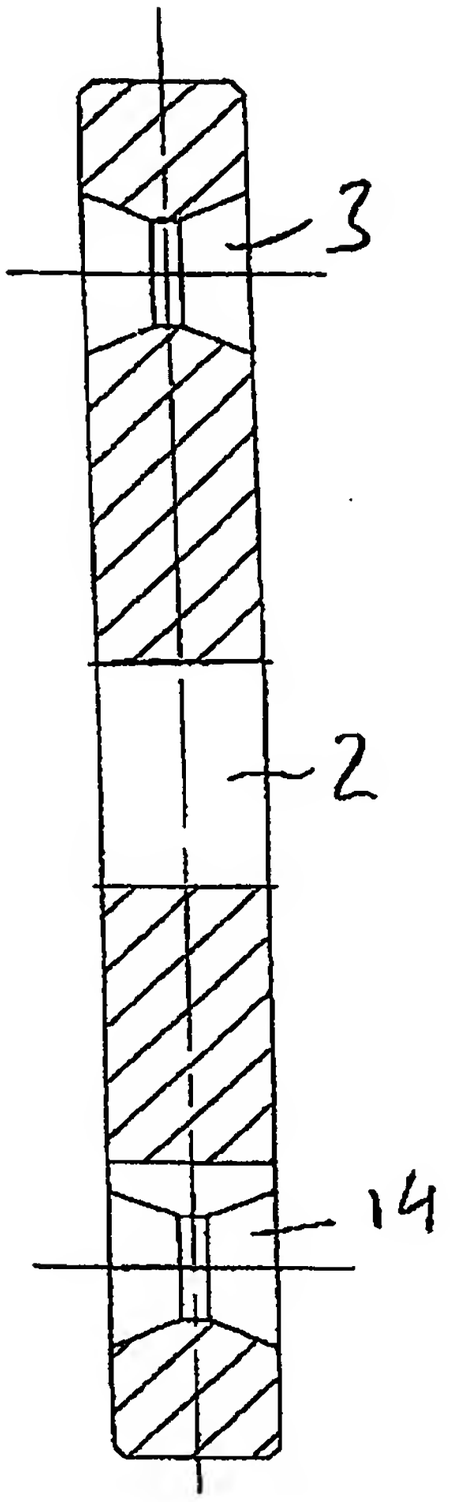


Fig 2B

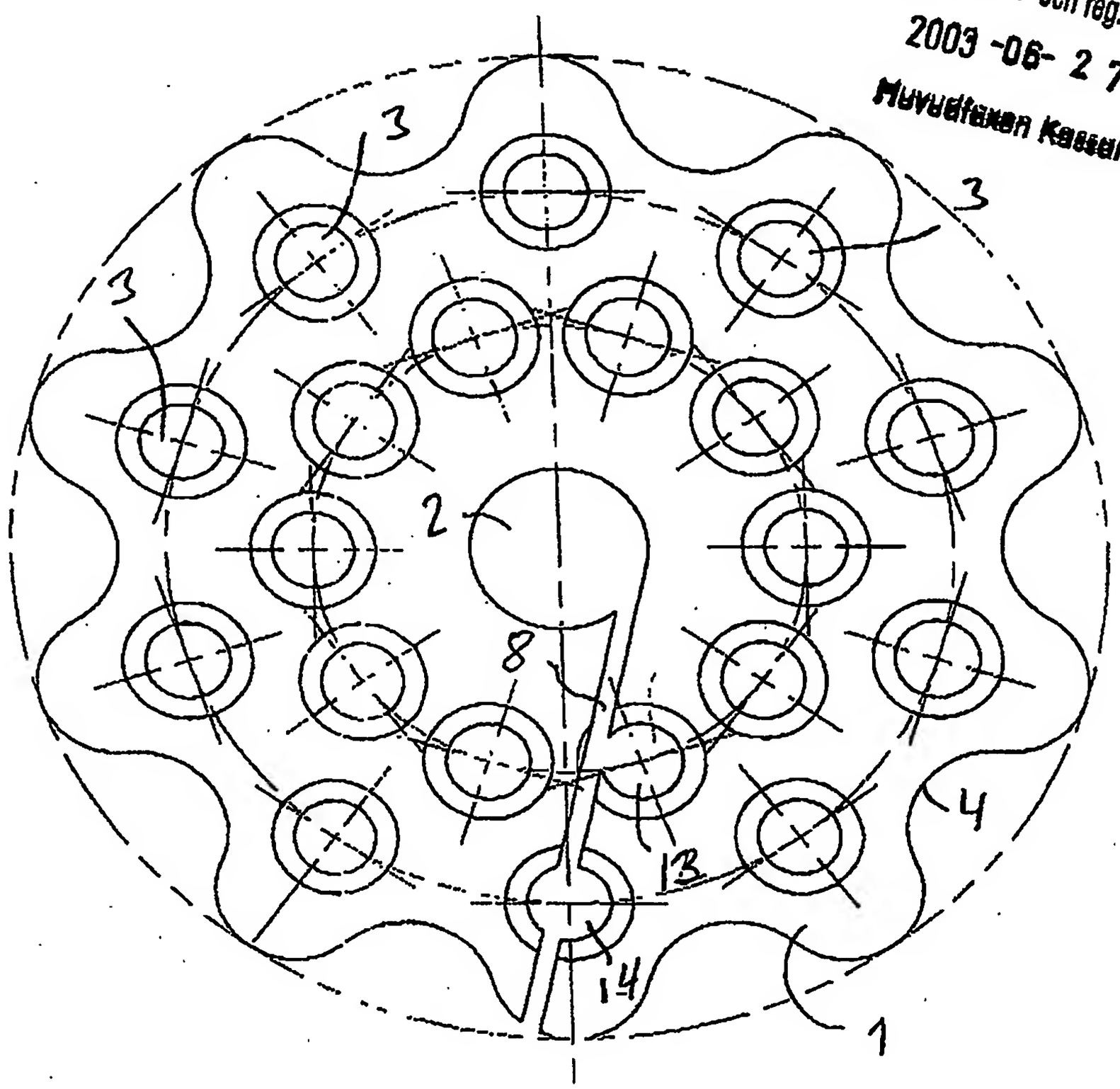


Fig 2A

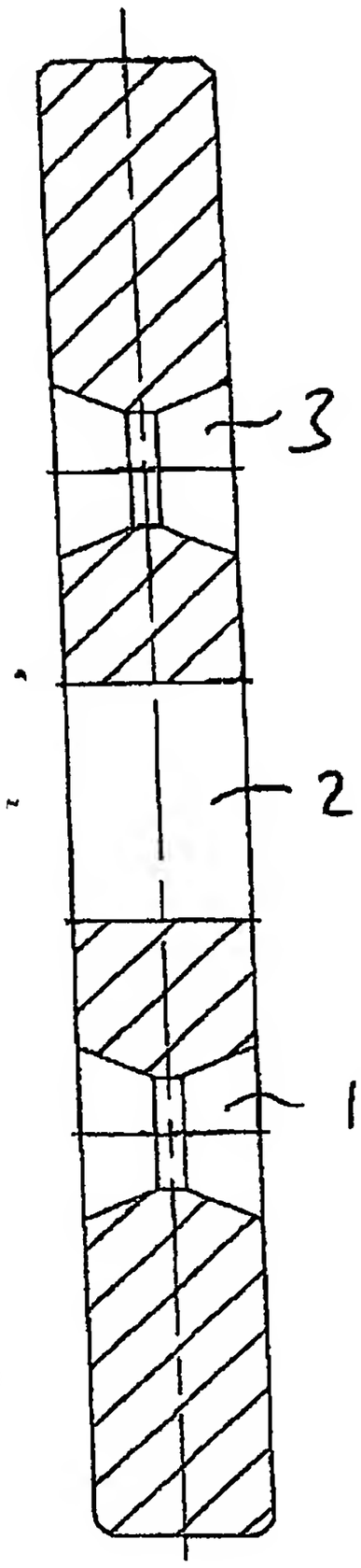


Fig 3B

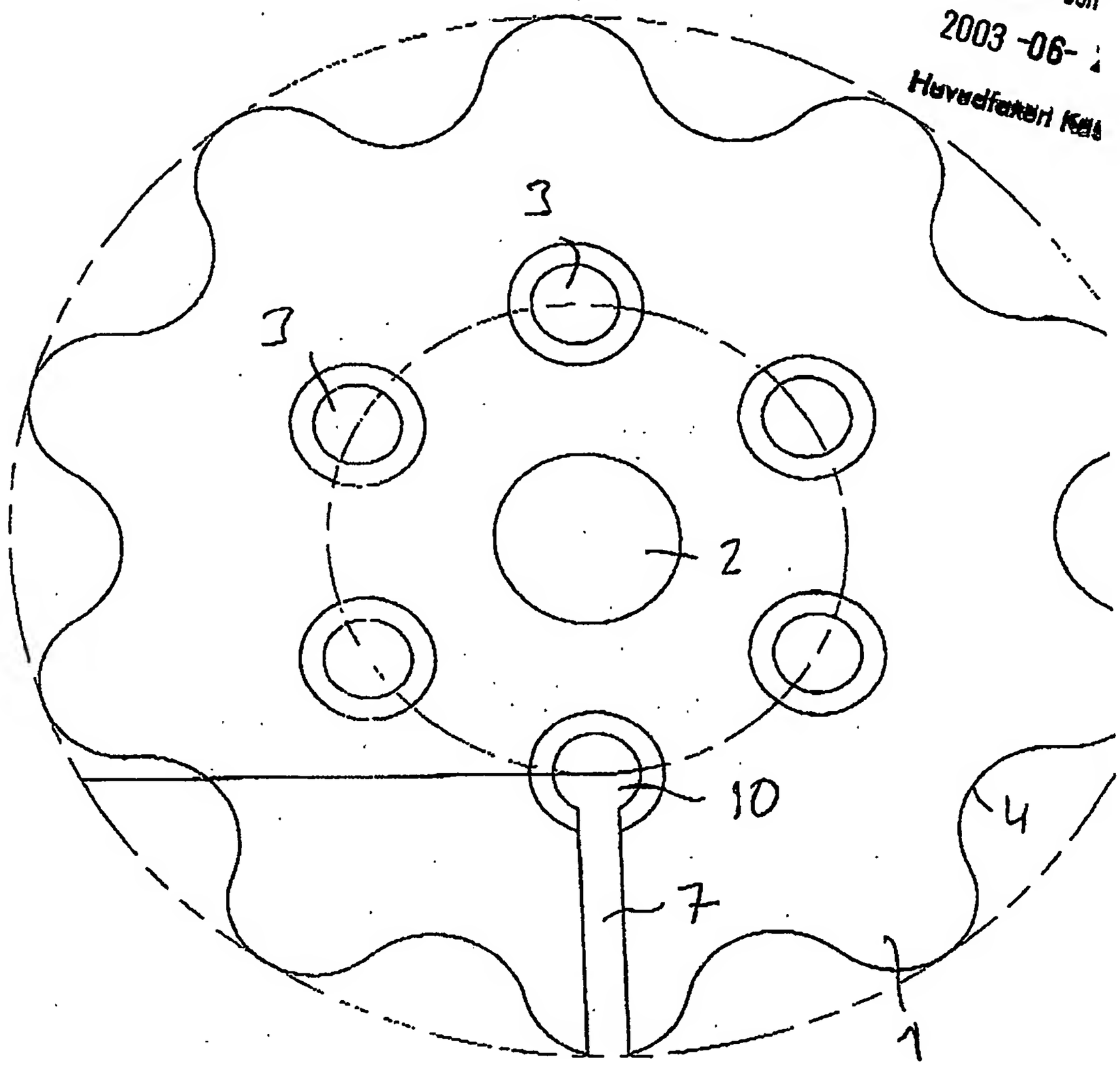


Fig 3A

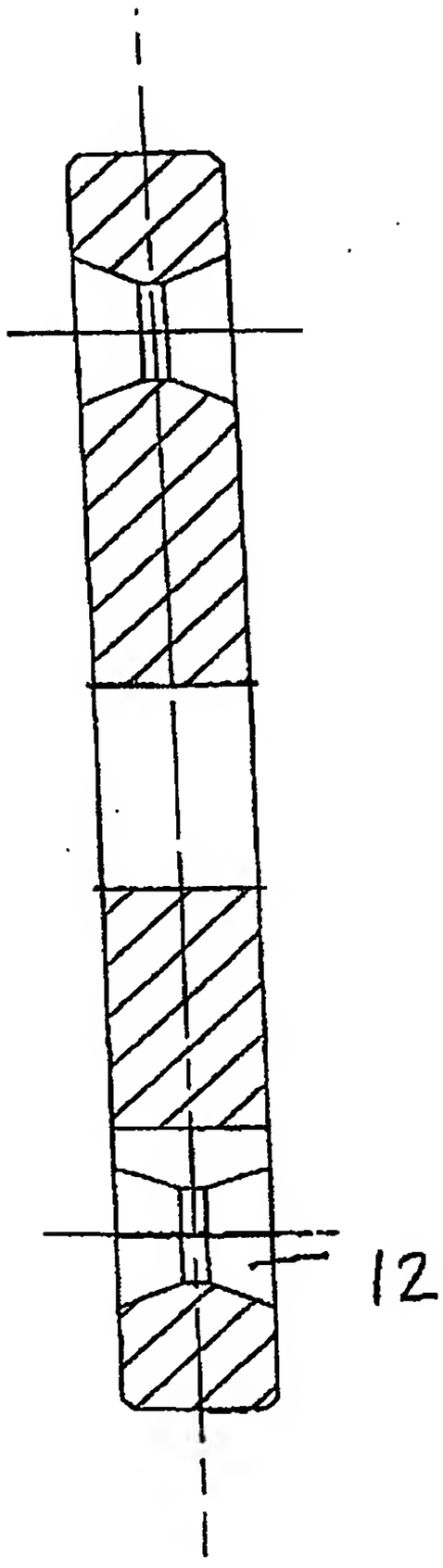


Fig 4B

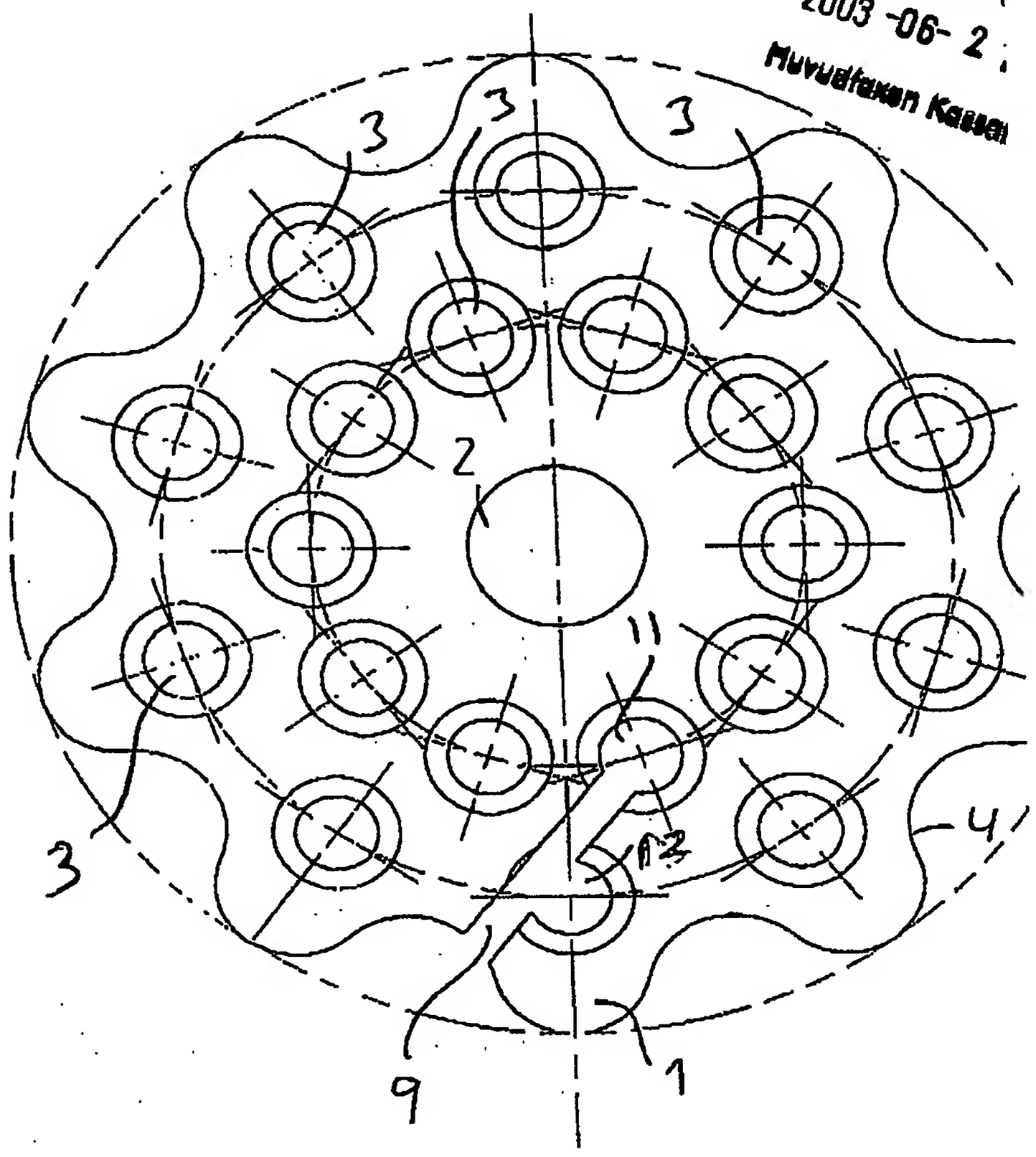
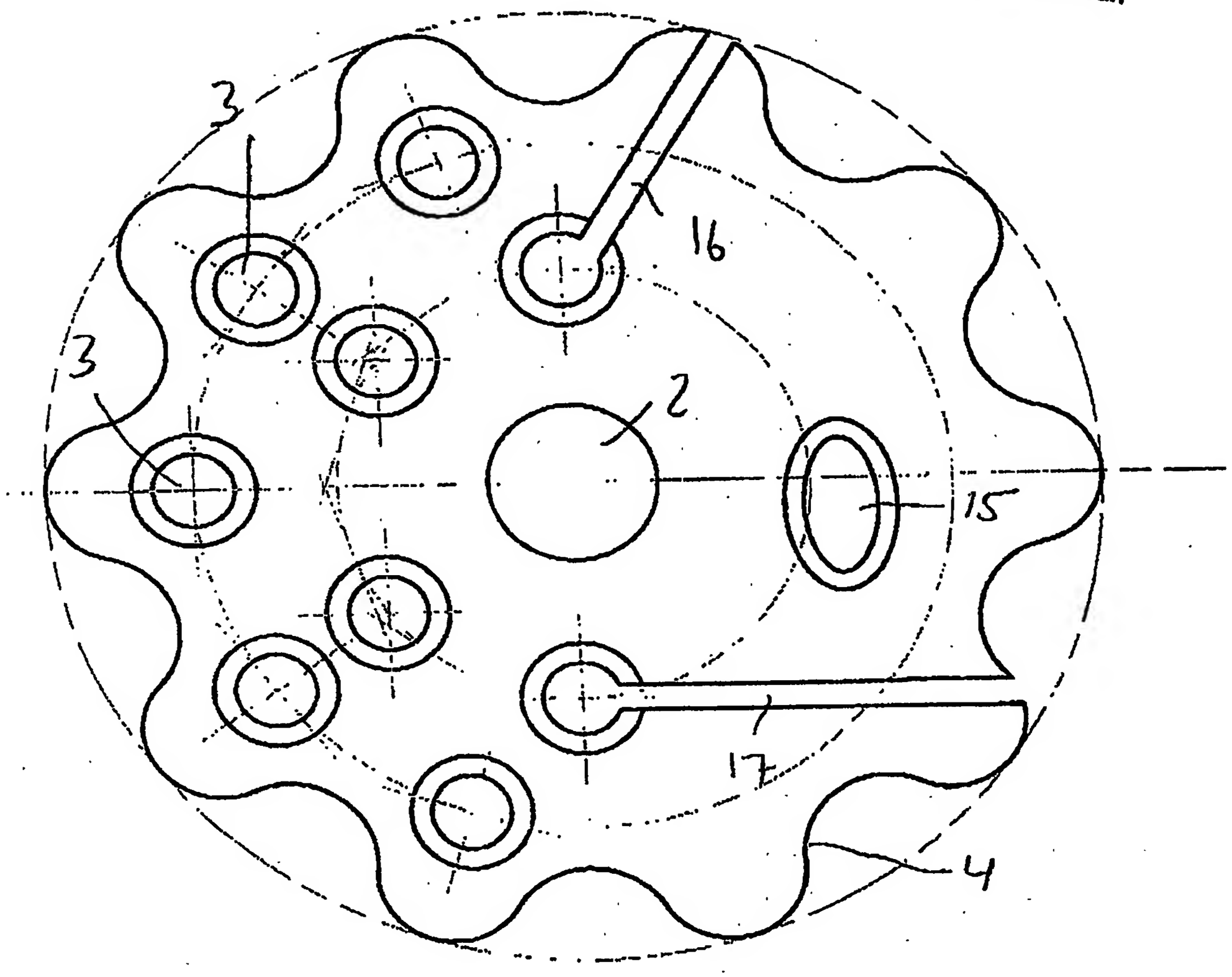


Fig 4A

Fig 5A



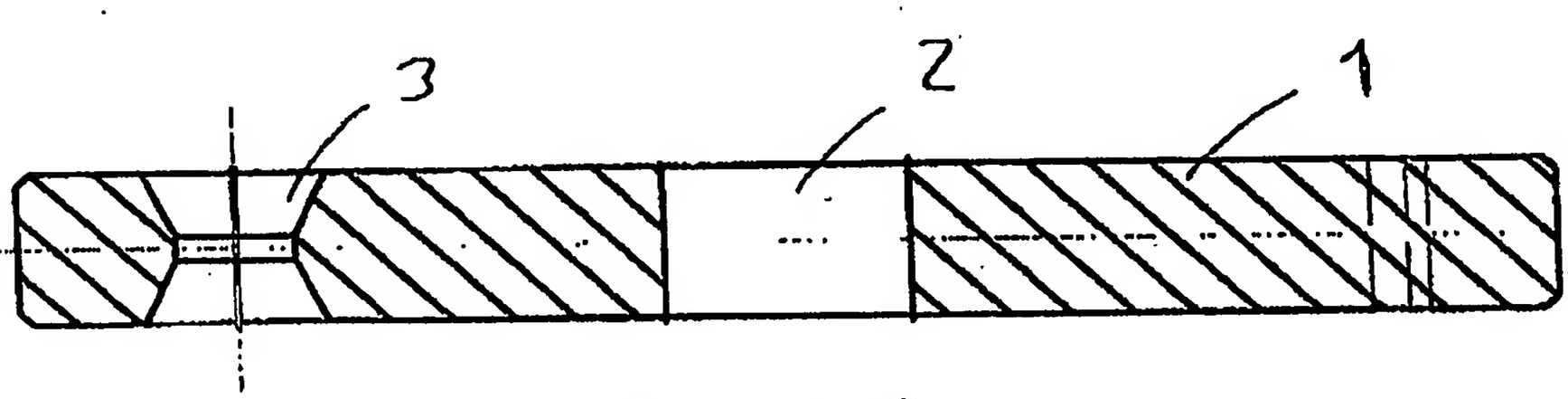


Fig 5B